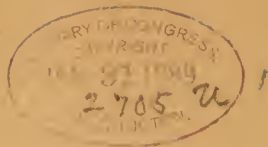


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N. S. SHALER,

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COURSE IN GEOLOGY.

THE aim of the instruction in this department is to give the students a training in the elements of geologic science, by means of text-books and monographs, combined with instruction of a practical sort in the laboratory and field. It is proposed to divide the work into two courses. In one, the student will follow an assigned plan of reading, at the same time pursuing such field observations as may be convenient for him to follow. In the second course the student is expected to attend the Harvard Summer School of Geology, taught in Cambridge, Mass., in the period from about July 10th to August 10th. He will be expected at least to attend, for the first two weeks of this, lecture, laboratory, and field instruction. The present circular concerns the work in the first mentioned of these courses. It is desirable that students who take up the subject of geology in the University and School Extension system should, where possible, resort to the Summer School after pursuing the designated course in reading and field observation.

In the first year of the work in this course, the instruction will be limited to the phenomena of dynamic geology. The student is advised to pursue the following reading. He may advantageously begin his task with Prof. James D. Dana's New Text Book of Geology. In this work he should read the whole of the text up to and including the 30th page, preparing himself to pass an examination on the matter. Great care should be taken to obtain a clear idea

of all the points which are the subject of definitions. In addition to the book above mentioned, the student may advantageously read Shaler's First Book in Geology (D. C. Heath & Co.), 2nd edition, taking the whole of the text. It is advisable to obtain the teacher's edition, which has an appendix containing directions as to field work. At any rate, if Dana's text book is read, it will be well to read the directions to teachers in the aforesaid appendix.

After completing this task, the student, if he has the time, may advantageously take Dana's Manual of Geology, following the large print of that text, up to and including the 113th page ; then passing to the 605th page, and likewise following the coarse print from that point to the 831st page. It is not deemed *necessary* that the student should undertake the study of Dana's Manual in the manner proposed. If he has an opportunity, after using the first two works named, it will be well for him to devote the principal part of his time to field observations. In case the field observations are not possible, then the reading should be extended to Dana's Manual. Students who apply for examination will kindly designate the extent of their reading.

As soon as possible after beginning his reading the student should undertake to observe geological phenomena of some limited field. Possessing himself of a copy of the best map which can be obtained, delineating an area of from five to twenty miles in extent, he may well undertake first to study the distribution of the soil or other detrital deposits within the field, depicting the facts by coloring placed on the map and setting forth the observations in a note-book. If the

district in which the area selected for study occurs be within the limits of glacial action, it will be well to trace the glacial scratches, if any occur, noting their compass course, also the direction in which the débris has been conveyed, whether it is stratified or not, whether it be of sand or clay, or the measure of mixture in the materials. At this point it will be well for the student to read the various essays of Prof. T. C. Chamberlin contained in the Annual Reports of the Director of the U. S. Geological Survey. These reports can be found in any public library, or can be secured by such libraries on application through the member of Congress of the district. It is not worth while for individual students to seek for copies by application in Washington. Chamberlin's treatises may be supplemented by reading Geikie's Great Ice Age, or Shaler & Davis's Illustration of the Earth's Surface, part first, Geology, R. Osgood & Co., Boston, in which a fair account of American glacial phenomena can be obtained.

In the study of his field, the student should pay close attention to the topography of the district. He should bear in mind the fact that every feature of hill or dale is due to the history of the field, in part to the structure of the under-rocks, and in part to the erosive agents acting through the sea, rain, rivers and glaciers. For some months the student had best limit his attention to these phenomena of surface geology without undertaking to study the underlying rocks. When he finds that he has gained a clear conception as to the form of the surface which is the subject of his inquiry, he should confirm his knowledge by drawing from memory a somewhat detailed map of

the area. He may then proceed to inquiries concerning the underlying rocks.

The first step in this second stage of work on a given field should consist in an effort to determine the character and attitude of different kinds of rocks which are found within it. For this purpose a second map of the area should be taken, the first being devoted entirely to surface geology, and on this latter sheet the strikes and dips as well as the limits of the different rocks should be indicated by appropriate signs. In case several kinds of rocks are exhibited within the same field, the circumstances of contact between the deposits should be studied with all possible care.

Where the student dwells near the shore, a portion of his field should, if possible, include a section of shore-line. Where he dwells in the interior, the area selected should include the path of a considerable stream, in order that he may observe the nature of the water work.

Although the area occupied by a city is not a favorable ground for geological study, it must not be regarded as totally unfit for such work. It is true a large part of the surface is hidden from view, but occasional sections made in the excavation of cellars afford on the whole better opportunities for seeing the understructure than are obtainable in most country districts. In case the student has not an opportunity to work in the country, he may well take up his field studies within the town. He may find an opportunity for certain

classes of inquiries in such areas which are of peculiar interest. Thus the effect of soil upon drainage, and consequently on the health of the population, can be advantageously studied in the limits of great towns. Moreover, in such towns there is a great range of building materials, and the effect of the action of the weather on such materials affords an interesting field of inquiry. Thus a student may train himself in observation, and make, indeed, a valuable contribution to economic geology, by a careful study of the building materials, bricks, mortar, as well as natural stones, which are used in any of our great cities.

It seems well to warn the student that in beginning his field work he is apt to encounter much discouragement from the apparently blind nature of his work. For a while his inquiries will appear purposeless. Gradually, however, as he gathers knowledge of the area which he is studying, his information will insensibly organize itself in his mind. In the course of a few months, understanding will take the place of doubt. In the process of this work, the student will do well at first to trust entirely to his own observations, and not to seek the aid of treatises which discuss the conditions of the field until, from his own study, he is prepared to have an individual opinion on the subject. He may then advantageously seek to learn all that others have said concerning the subject matter of his inquiry.

Although the student may, if he be willing to devote himself to the subject, advantageously begin the study of geology alone, with no



help from a teacher beyond that which may be obtained by printed matter or correspondence, it will be well if, at the end of a few months after he has undergone the difficulties of field inquiry, he should for a few weeks receive the advice and instruction of competent teachers. A large part of geological science, as well as of all other branches of practical learning, consists of traditions based on experience of innumerable field workers—traditions which the beginner will do well to acquire. Therefore the student is advised during the summer season, for a period of from two to six weeks, to attend a summer school of geology, wherein he may make acquaintance with these technical details, and also have an opportunity of studying a field along with experienced field workers. He will then be ready to return to his individual inquiries much strengthened by his contact with men who make geology a profession.

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